Exploring segregation and sharing in a divided city: A PGIS approach

Exploring Segregation and Sharing in Belfast: a PGIS approach

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Abstract

This article presents a novel exploratory investigation into the location and characteristics of spaces that are segregated and shared between Protestant and Catholic communities in Belfast, Northern Ireland (UK). Focusing upon a particularly segregated part of the city, this study uses state of the art participatory GIS and visualisation techniques to create qualitative, 'bottom up' maps of segregation and sharing within the city, as experienced by the people who live there. In doing so, it identifies important and previously un-reported patterns in segregation and sharing between sectarian communities, whilst challenging normative approaches to participatory GIS and illustrating how alternative methods might provide deeper insights into complex social geographies such as those of segregation. Finally, the findings of this work are formulated into a set of hypotheses that can contribute to a future research agenda into segregation and sharing, both in Belfast and in other divided cities.

Keywords: *segregation, PGIS, visualisation, non-place*

Introduction

This article constitutes a novel, exploratory investigation into the segregation and sharing of space in Belfast, Northern Ireland (UK) that utilises new developments in Participatory GIS (PGIS) methods in order to gain unique insights. Spatial patterns in segregation have been widely studied in the literature, with analysis conventionally based upon administrative tessellations such as census tracts, normally due to the ease of availability of these datasets and methods that employ them, as opposed to their suitability for the representation of the phenomena in question (Hasanzadeh et al., 2017; Evans and Waters, 2007; Grannis, 2005). In fact, these administrative tessellations are poorly suited to the representation of the complex social processes that dictate everyday community interactions, and most recent literature typically promotes the use of more individualistic approaches (Hasanzadeh et al., 2017). This is because these tessellations are generally designed to have administrative, rather than social or cultural significance, leaving them at odds with the ways in which people understand their surroundings. In spite of this understanding, the use of arbitrary administrative tessellations still persists in many areas of research and even where more individualistic approaches are taken they still tend to rely on the use of precisely defined regions (e.g. Hasanzadeh et al., 2017).

Dixon et al. (2008) discuss the way in which the abstracted representation of different groups in the segregation literature eclipses the day-to-day practices, routines and experiences of ordinary people on the ground. The present research seeks to bring those everyday practices to the fore, using exploratory PGIS and visualisation techniques in order to create unique ‘bottom-up’ perspectives on segregation that cut across the traditional, abstracted geographies of segregation. Following a review of the literature, an alternative approach will be presented in which subjective

geographical information generated by the public may be visualised and interpreted, revealing the complex geographies that influence the nature of interactions between groups in Belfast. In so doing, this work will challenge the methodological 'status quo' that exists in mapping the perception and experience of segregation in cities. It will also formulate a set of hypotheses, designed to inform a new agenda for further geographical research into segregation and sharing in 'divided cities', both in Belfast and more widely.

Literature Review

Segregation in Belfast

Segregation is a feature of most cities (Boal, 1978) and is typically described as the spatial separation of residences and/or activities between groups that are distinguished by religion, ethnicity, socio-economic status, or similar attributes. It is well understood that segregation is experienced on an individual basis and that those experiences are influenced by many factors including age, gender, social background and place of residence (Roulston and Young, 2013). The issues surrounding segregation are complex. Some researchers have highlighted the role of segregation in maintaining social inequality and concentrating poverty in particular areas of the city (Massey & Denton, 1993; Massey & Fischer, 2000), though others have occasionally highlighted cases where segregation may actually perform a positive role within the city, such as in situations of intense inter-group conflict (Boal, 1996; 1971). Nevertheless, in the case of Belfast, segregation is sustained and reinforced by the memory of politicised readings of history, as well as countless acts of brutality and violence, perpetrated because the victim is (or is perceived to be) different from the perpetrator (Hamilton et al. 2008).

These complexities are reflected in historic policy in Belfast. In 1969, the first *peace walls* and interface barriers were used to separate conflicting Catholic and Protestant communities and moderate intercommunity violence. These barriers have gradually spread across many areas of Belfast and actually increased in number and size in the post-conflict city (Belfast Interface Project, 2017). However, government policy is now changing and current policy seeks to remove these physical barriers and encourage interaction between the communities (Executive Office, 2013). At a time of such significant change, a better understanding of the location and characteristics of areas of the city where segregation and sharing are taking place can inform such policies and so help to promote desegregation and sharing in the future.

It is well known that segregation and sectarianism are everyday realities for many residents of Northern Ireland (Roulston and Young, 2013), whereby basic daily routines and practices are frequently governed by the dominant sectarian divisions of Northern Irish society (Hamilton et al. 2008). Belfast, the capital, is a 'divided city' following decades of conflict and violence that continues to impact upon interactions and relations between the two main communities in Northern Ireland: Catholics and Protestants (Merrilees et al. 2017; Roulston and Young, 2013). The issues surrounding both groups and the conflict that they share is, however, far more complex than this religious nomenclature suggests: the chief driver of the conflict is arguably ethno-political, with *Unionist* Protestants tending to identify as British and wishing to remain part of the United Kingdom and *Nationalist* Catholics tending to identify as Irish and wishing to unify with the Republic of Ireland (Merrilees et al. 2017; Roulston and Young, 2013; MacGinty, 2007).

Despite the 'Good Friday Agreement' officially ending the conflict in 1998, many citizens still continue to live segregated lives in Belfast with, for example, 93 percent

of children continuing to attend segregated schools (Northern Ireland Department for Education, 2017; Merrilees et al. 2017). Moreover, residential patterns, particularly in the north of the city, persist in a distinctive 'checkerboard' pattern in which nationalist and unionist communities exist in close proximity, yet remain divided in their everyday activities and use of space. Communities have historically enforced these divisions using intimidation, rioting and violence, the erection of physical barriers, and the marking of spaces with flags and graffiti (which ranges from informal slogans painted on walls and street furniture to complex, semi-permanent murals) (Mitchell and Kelly, 2010; Bryan and Stevenson, 2009; Leonard, 2007; Boal 1971). The peace walls and murals in particular have become well-known landmarks of the city and even drive a 'dark tourism' industry upon which many local companies now capitalise (Mitchell and Kelly, 2010; Radford 2017).

Various forms of peace-building have taken place over the years, including the redevelopment of Belfast's economy and architecture, the regeneration of derelict spaces, the 're-imaging' of areas marked by flags and murals and the widespread funding of a service-based voluntary sector to promote reconciliation and social and economic development (Mitchell and Kelly, 2010). However, such attempts at peace-building have generally had most impact in the central parts of the city, leading to a relatively integrated and 'peaceful' city centre, but a very visible 'urban hinterland' where sectarian enclaves are considered as places to which the peace-building process will be 'later extended' (Mitchell and Kelly, 2010). The northern part of the city may be considered as archetypical of such a hinterland, with the sectarianism still remaining a prominent characteristic. For this reason, this study will focus upon this part of the city, exploring how local residents perceive and experience urban segregation.

The Experience of Segregation

The experience of segregation is necessarily incompatible with the 'official' administrative boundaries that are imposed upon the city by the authorities. For example, when considering the extent of their *neighbourhood* or *territory*, humans will typically not refer to or even consider the precise boundary, instead referring to some commonly held notion of *place* (Hadzilacos, 1996; Varzi, 2001; Evans and Waters, 2007). This condition is geographical *vagueness*, which represents an essential part of how humans perceive and understand the world (Fisher, 2000) and is a vital and omnipresent component of geographical information (Duckham, 2009; Goodchild, 2011; Mackaness and Chaudhry, 2013). Wood (2011, p1) sums up this condition, stating that: *"when you look really hard at a neighbourhood, it is impossible to miss how uncertain its edges are"*. In such cases, socially constructed bounds should not merely be considered as *undetermined*, implying that there are precise boundaries that have not yet been determined; but rather as *indeterminate*, whereby there are no universal bounds to be defined, even if desired.

In spite of this, it remains the habit of researchers and decision makers to formalise those regions with precise boundaries when communicating that information digitally, even though this practice has long been understood as highly unsatisfactory (Goodchild, 2011). Peuquet (2002) considers the impact of this situation, suggesting that the data model often dictates the user view and the kinds of analyses that are performed, rather than the other way around. As a result, the vast majority of studies of urban segregation are based upon the analysis of distributions of people across sharply defined areal units (e.g. census tracts, wards, and similar 'output areas') that effectively obscure how such people themselves define their environments.

Kwan (2009) questions the approaches widely adopted in the literature, expressing her puzzlement as to *"why studies would start from some arbitrary definitions of place or neighbourhood instead of considering the actual geographies through which individuals experience the kind of exposure in question"* (Kwan, 2009: 1312). In fact, the reason for the pervasive adoption of such techniques is that these precise representations are simple to work with, have clear qualities and attributes, can be analysed using standard geometric algorithms, are compatible with many complementary datasets (e.g. the census), and are generally accepted by other researchers, decision makers and the public as the 'normal' way in which these data should be managed (Evans and Waters, 2007). In the segregation literature, for example, the use of standard areal output regions has enabled researchers to capitalise upon government census data about who lives where in cities and to estimate nature and degree of segregation using standardised statistics such as the Index of Dissimilarity (Massey & Denton, 1988). However, whilst such datasets are useful for establishing broad patterns of residential segregation, they neglect the ways in which people think about, experience, and utilise geography in their daily lives (Evans and Waters, 2007), and are perhaps more reflective of historical cartographic practice and the limitations of early computers than of their suitability for the task (Schneider, 1996; Clementini and di Felice, 1996; Usery, 1996; Evans and Waters, 2007; Silvan-Cardenas, 2009). It is clear therefore, that new, complementary methods are required in order to permit a greater understanding of complex social phenomena such as segregation.

Neighbourhood and Individualistic Approaches to Segregation

Attempts to better understand the geography of social phenomena such as segregation have been become something of a "rallying theme" in the literature (Farber et al.,

2012: 316), and wider recognition that the experience of space is not confined to the somewhat arbitrary administrative boundaries has caused a notable shift towards the use of more individualistic approaches. Kwan (2009) contextualised the problem of administrative boundaries with the Modifiable Areal Unit Problem (MAUP; Openshaw, 1984), and posited that individualised measures would let values vary for individuals who would otherwise be homogenised as members of the same zone. She thus called for the development of 'people-based' rather than 'place-based' measures to be used in future research.

Wong and Shaw (2011) sought to answer this call by building activity spaces into their analysis, permitting them to move away from reliance only upon residential information at the expense of other socio-geographical patterns. Using travel diaries and an exposure index as a measure for activity space segregation, they were able to provide a quantitative index for segregation that incorporates individual data. Similarly, Farber et al. (2012) explored the use of local statistics in order to create a spatially expanded model of trip length in order to assess mobility, from which statistically testable maps of clustering and exposure could be derived. However, whilst both of these approaches represent a clear step-forward, they are still dependent upon aggregated census data, and their results therefore remain constrained by reliance upon administrative boundaries that may have limited relevance to residents' own understandings of their everyday environment.

Participatory GIS

The above discussion highlights a fundamental incompatibility between the abstract, geometric, 'top-down' approaches to GIS, and the rich, indeterminately bound, 'bottom-up' local knowledge that is required in order to build up a detailed picture of the geographies of segregation and sharing in places such as north Belfast. The

resolution of this condition has frequently been highlighted as a key research area for geographical information science (Ballatore, 2016; Hobel et al., 2016; Goodchild, 2011), and nowhere is it more important than in the field of PGIS, which is concerned with the development of systems designed to collect this rich 'bottom-up' geographical information from the public (Huck et al. 2014).

Yet traditionally, PGIS approaches have either ignored vagueness, making entities *artificially precise* (Montello et al., 2003), or have assumed that the individual points or polygons provided by multiple participants will *"converge on a collective spatial 'truth'"* (Brown and Pullar, 2011). Whilst such assumptions may be acceptable for certain applications, they are not sufficient where data relate to complex social phenomena such as segregation. In such cases, the imposition of *artificial precision* upon the geographical thoughts and feelings of the public can prove misleading, with data wrongly assumed to exhibit a level of precision and accuracy because it is presented as such (Hollenstein and Purves, 2010, Mackaness and Chaudhry, 2013).

Nevertheless, despite widespread recognition that discrete models are inadequate for many applications, few alternatives have been presented and none have been widely adopted in the PGIS literature, either with respect to segregation or other applications. PGIS methods (though not by that name) could be considered as having been applied to segregation as early as the 1970s. Boal (1971) sought to map Belfast community members' perceptions of the extent of *'their area'* by asking participants to verbally describe *"How far does your area extend in each direction?"* and then drawing the resulting regions (as bounding boxes) based upon the most commonly cited landmarks. As recently as 2016, Goldblatt and Omer (2016) considered the measurement of *'perceived neighbourhoods'* in their study of segregation (in Jaffa, Israel), collecting boundaries that were sketched by participants and then digitised by

the researchers. However, in spite of the recognition of the requirement for the better representation of perceived neighbourhood extents, both of these studies and many more in the intervening period require the participant to reduce their notions of '*neighbourhood*' to precise bounds, thus suffering from the *artificial precision* identified by Montello et al. (2003).

PGIS approaches have also recently been applied to the modelling of activity space. Hasanzadeh et al. (2017; 2018), for example, sought to model individual 'home ranges' using data from participants who were asked to mark their home and frequently visited locations as points on a map. These points were then buffered in an attempt to account for the inherent 'fuzziness' (*vagueness*) in the point locations and then enclosed by a convex hull to delineate the home range. Whilst there are some substantial benefits to this approach, it still results in a rather arbitrary boundary around each place of interest, which is then exacerbated by the use of a convex hull to create a crisp polygon. The result may, in fact, be better considered as a maximal home range, which likely contains the true representation, but does not reflect its true nature and might be considered as being similarly arbitrary to the administrative areas that they avoid.

Maslow's (1966 p.15) 'law of the instrument' states "*I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail*". Here, Maslow identifies a type of cognitive bias: over-reliance upon a familiar tool. Such a condition is analogous to the use of conventional GIS approaches for the collection of indeterminate information in PGIS. In order to facilitate the exploration of alternatives to this 'hammer' of conventional GIS representations, researchers should seek to ensure that the participant, rather than the system, dictates the nature of the representation. The present research, therefore, seeks to provide a novel methodology

that will permit the collection of empirical socio-spatial data from the public that is able to embrace the inherent vagueness and perceived form of the areas without the imposition of artificial precision at any stage. In doing so, this work will challenge normative approaches to both PGIS and the understanding of segregation in order to reveal new, richer, 'bottom-up' perspectives on segregation in Belfast.

Methodology

Hamilton et al. (2008) consider that research into segregation may be divided into two main forms, the anthropological and the geographical: whereby the anthropological school focuses upon the use of qualitative data to explore the practices of segregation; and the geographical school focuses upon mapping and quantifying segregation. This work seeks to combine these two approaches, by presenting a qualitative geographical approach that is able to collect and map qualitative, indeterminate notions of segregation, so that a greater understanding of these complex social patterns may be achieved.

To this end, a novel combination of PGIS and visualisation techniques were used to develop a survey that was completed by 33 participants between February 2016 and February 2017. Participants were recruited by door-to-door survey from a number of areas within North Belfast representing well-established working-class communities of Catholics and Protestants. Of the 33 participants, 14 declared as Catholic, 17 as Protestant and 2 as 'Other' (i.e. they did not identify with either community) and 21 declared as male and 12 as female. Participant characteristics are summarised in Table 1. Each participant was asked to complete a short demographic questionnaire followed by four map-based PGIS questions.

Table 1: Summary participant origin for the PGIS participants

Community Group	*Community Name*	*Number of Participants*	*Total Participants*
Catholic	Ardoyne	4	14
	Glandore	3	
	Ligoniel	1	
	New Lodge	3	
	Whitewell	3	
Protestant	Ballysillan	2	17
	Glenbryn	2	
	Skegoniell	4	
	Tiger's Bay	6	
	White City	3	
Other	Ardoyne *(Catholic)*	1	2
	Skegoneill *(Protestant)*	1	

PGIS Data Collection

The survey data for this research was collected using the freely available Map-Me PGIS platform (http://map-me.org), which was introduced by Huck et al. (2014) as a means of collecting geographical information from the public using an airbrush-style interface, herein referred to as the *Spraycan*. Using this interface, indeterminate regions are represented by a collection of 'dots' with shared attributes. These 'dots' are pseudo-randomly [1] 'sprayed' onto the map within a given radius of the participant's cursor, preventing the precise positioning of the 'dots' by the participant whilst permitting strength of feeling to be reflected by the density of the 'dots'. Whilst each 'dot' is necessarily a precise coordinate pair, they have not been precisely located by the user, and are only ever considered as a collection (a '*spray pattern*').

[1] In computing, numbers that are truly random are expensive to calculate and are typically only used for cryptographic applications (whereby the ability to reproduce the numbers would comprise a security flaw). Otherwise, it is commonplace to use 'pseudo-random' numbers, which satisfy one or more statistical tests for randomness, but are produced by a definite mathematical procedure and so could, in theory, be reproduced.

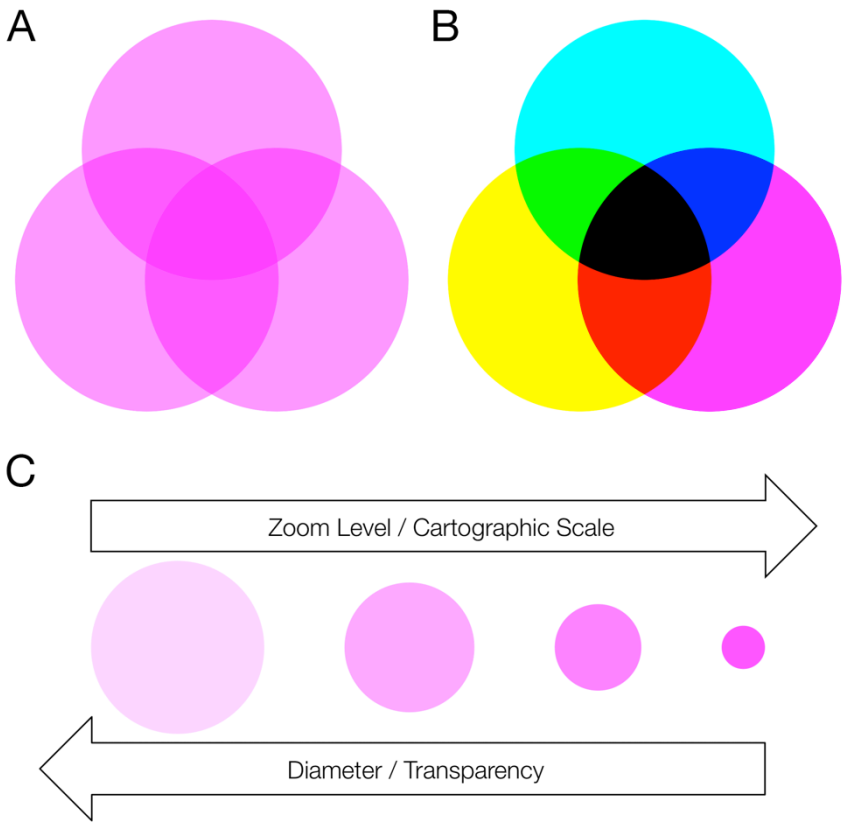

Figure 1. (A) The transparency, (B) the multiply colour composite and (C) the zoom-level-based *mapping effort* weighting used in the visualisation of data from the Spraycan. In combination, these approaches permit density and interaction between up to three classes to be visualised.

In contrast to Huck et al. (2014), who used kernel density surfaces and map algebra in order to quantify the data that they collected, this study presents the data collected from both PGIS approaches using a qualitative, exploratory visualisation approach in which colour composite operations are used in order to reveal the location of, and interaction between, up to three possible classes of data (Catholic, Protestant and 'other'; or Catholic, Protestant and 'mixed' communities in this case). With the combined use of transparency overlay (illustrated in Figure 1A) and a 'multiply' colour composite operation (illustrated in Figure 1B), a visual impression of 'accumulation' and 'blending' is achieved, whereby an increasing volume of spray provides a darker shade, whilst overlapping data from different variables 'blend' to

produce a new colour (e.g. magenta and cyan make blue, showing that both classes are present). This 'exploratory visualisation' is intended to exploit the strengths of both human and computational data processing (Kraak, 2011), and allow individual map-readers to understand spatial patterns with minimal influence from the GIS.

PGIS data has traditionally been quantitatively validated against 'authoritative' datasets, an approach that Brown (2017) refers to as *'validity as accuracy'*. In the collection of subjective opinion from the public, however, no such 'authoritative' dataset can exist, so Brown (2017) proposes an alternative *'validity as credibility'* approach, suggesting *mapping effort* as a surrogate for quality. This approach is based upon the presumption that respondents with lower levels of motivation will engage in '*satisficing*': producing suboptimal data that are less reflective of their thoughts and feelings; whereas more highly engaged respondents will engage in '*optimisation*': producing higher quality representations of their meaning (Kaminska et al., 2010; Kroskick, 1991).

Zoom level is the mechanism by which Spraycan users control both the level of precision and density of spray (Huck et al., 2014), and so will be adopted as a reasonable proxy for 'mapping effort' for the purpose of this research. To this end, the transparency and diameter of each 'dot' of 'paint' will be varied according to the zoom level at which it was produced. The intended effect of this approach upon the resulting visualisation is that each 'dot' will contain the same overall intensity of colour, but those sprayed at a smaller geographical scale (zoomed out) will be more 'spread out' (more transparent, larger in diameter) in comparison with those sprayed at a larger geographical scale (zoomed in), which will be more focussed (less transparent, smaller in diameter). The resulting map will therefore show perceptions

of community affiliation, weighted by ‘mapping effort’. This approach is illustrated in Figure 1C.

When taking part in the survey, each participant began with the map centred upon their own neighbourhood, though they were free to pan and zoom to other parts of the city if they wished. The base-map was the standard Google Map ‘Streets’ layer (though the participant was free to switch between any of the standard Google Map layers) and the bounds of the study area were not marked on the map, nor was the participant confined to it. The Spraycan survey comprised four simple questions, which did not explicitly refer to either residences or to specific activities, instead remaining open to interpretation:

1. *Please spray the areas you would consider to be Catholic*
2. *Please spray the areas you would consider to be Protestant*
3. *Please spray the areas you would consider to be mixed*
4. *Please spray any local areas that you would define as public spaces that are shared by both communities*

Participants’ responses to questions 1-3 will be visualised together using the approach described above (with the ‘Catholic’, ‘Protestant’ and ‘mixed’ classes symbolised as cyan, magenta and yellow respectively) in order to produce a map of perceived ‘community affiliation’. Responses to question 4 will also be mapped using the same technique, but in this case the colour for each ‘dot’ of paint refers to the community affiliation of the participant that sprayed it (e.g. a cyan area suggests a location that Catholic participants considered to be shared), with yellow used for participants who specified that they considered themselves as being part of an ‘other’ community.

Complementary Datasets

As has been demonstrated above, there is no single authoritative dataset that can be used to quantitatively 'validate' a PGIS dataset that represents participants' perceptions and experiences of segregation. However, a number of complementary datasets will be employed for qualitative, visual comparison in order to permit a critique and evaluation of the PGIS dataset described above. The first such dataset will be Northern Ireland Small Area (SA) data of the 2011 census, which has been mapped as a traditional choropleth divided into 5 classifications of either 'mixed' (<60 percent dominance of either community), 60-80 percent dominance of Catholic or Protestant residents, or >80 percent dominance of Catholic or Protestant residents. Whilst there is no broadly accepted threshold for 'segregated' or 'mixed' areas, these figures are broadly in line with those presented in a review of such approaches by Hamilton et al. (2008). The classes have been mapped using the same colour scheme that was used for the Spraycan data and the dataset has been clipped to the extent of the same, in order to facilitate comparison. Whilst there are numerous (previously discussed) limitations to these administrative boundaries and they will certainly obscure nuanced patterns, the broad patterns of community affiliation may provide a useful comparison with the alternative PGIS dataset collected using the Spraycan.

The second complementary dataset used in this study will be a dataset of the locations of roadside partisan election materials, collected by one of the authors during the lead up to the UK general election that took place on 8th June 2017. The author walked the main roads over much of the study area and noted the affiliation of the roadside election materials on a blank map, which was then scanned and georeferenced so that the dataset could be digitised and mapped in a GIS. Due to the strong ties between the main political parties in Northern Ireland, with *Sinn Féin* and the *Social Democratic*

and Labour Party (SDLP) representing the Catholic communities and the *Democratic Unionist Party* (DUP) representing the Protestant communities; election materials for these parties act as prominent markers for sectarian territory in Northern Ireland, and so provide a useful bench-mark for both residential and activity-space segregation.

The third complementary dataset is a collection of GPS traces from participants using a bespoke Android mobile application (available open source at huckg.is/bmp/app). The dataset of GPS traces was collected by the authors during the same time period as the PGIS data as part of a mobility study from 196 local participants, who self-identified as being members of Catholic, Protestant or 'Other' communities. Their movements were recorded at 4-second intervals for a period of up to a fortnight, resulting in 21,651,269 data points. A breakdown of participant community affiliation and journey time by community is given in Table 2. In order to facilitate comparison between patterns in the PGIS data and the GPS data, the same visualisation technique as above was used when mapping the GPS traces, whereby each GPS point is coloured according to the community affiliation of the participant that recorded it. This dataset provides a unique insight into the movements of community members and interactions between members of different communities, and so provides a useful benchmark for activity-space segregation and sharing.

Table 2: Summary of Journey details for the GPS tracking volunteers

Community	***Number of Participants***	***Total journey time (hours)***	***Mean journey time per person (hours)***
Catholic	93 *(50 Female, 43 Male)*	446:10:11	04:47:51
Protestant	92 *(63 Female, 29 Male)*	435:11:41	04:43:49
Other	12 *(5 Female, 7 Male)*	54:42:07	04:33:30

Results and Analysis

Perceptions of Community Affiliation

The Spraycan dataset for perceptions of community affiliation, weighted by 'mapping effort', are shown in Figure 2A. As might be expected, this map shows a great deal of perceived segregation between the residential areas that are occupied by Catholic (cyan) and Protestant (magenta) communities, with relatively few areas denoted as 'mixed' (yellow). There are also low levels of disagreement between the various groups (red, green, blue, black), reinforcing the notion of a 'shared understanding' of boundaries existing between communities.

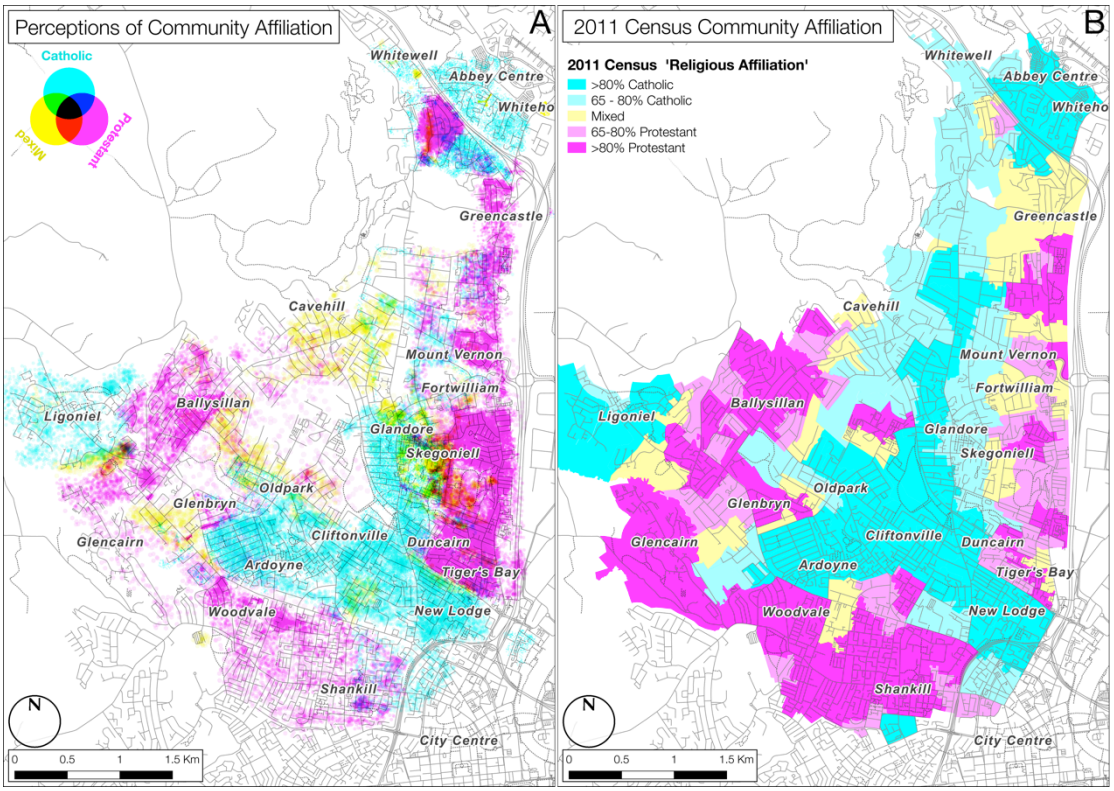

Figure 2: (A) Map of perceived community affiliation spray patterns weighted by mapping effort. An interactive version of this map is available at huckg.is/bmp. (B) 2011 Census data, Small Area census data, classified by % resident declared religious affiliation. *Road and suburb data © 2017 OpenStreetMap Contributors.*

Notwithstanding standard criticisms of visual bias in choropleth maps arising from the varying size of the SA's (which are derived from postcode areas; Northern Ireland Statistics and Research Agency, 2017), the MAUP (Cohn et al., 2011; Kwan 2009; Wong, 2003; Openshaw, 1984), the requirement for complete areal coverage, and the enforcement of artificial precision (as discussed above); the broad patterns in the Spraycan data are reinforced by the SA census data in Figure 2B. Whilst the broad patterns match well, however, there are numerous nuanced disagreements that demonstrate a disparity between the census data and public opinion, such as the well established Protestant community of Greencastle being classified as 'mixed' in the census data (similar patterns can be seen around other well-established sectarian strongholds such as Ardoyne, Tiger's Bay and Skegoniell), and the large area at Cavehill towards the centre of the map that is considered as 'mixed' in the Spraycan data being considered as strongly Catholic according to the census.

These disparities can be further investigated by the addition of the dataset of roadside election materials to the maps, as can be seen in Figure 3. Once again, the broad pattern of election material distribution matches well with those shown by the Spraycan (Figure 3A) and SA census (Figure 3B) datasets. However, if we now revisit Cavehill, which is shown as 'mixed' in the Spraycan dataset and 'Catholic' in the census dataset, it is clear that the whole area is occupied by a mixture of both *Sinn Féin / SDLP* (Catholic) and *DUP* (Protestant) election materials (one on each side of the road, as illustrated in Figure 3). This lends support to the characterisation of the area as 'mixed', and so lends further support to the notion of a disparity between the 'authoritative' census data and 'bottom-up' public opinion. Though the election material dataset unfortunately does not reach as far north as Greencastle, the *DUP* election materials present in the 'mixed' SA's at Tigers' Bay and Skegoniell (both of

which are, in reality, well-known segregated communities) also lend further support to this argument.

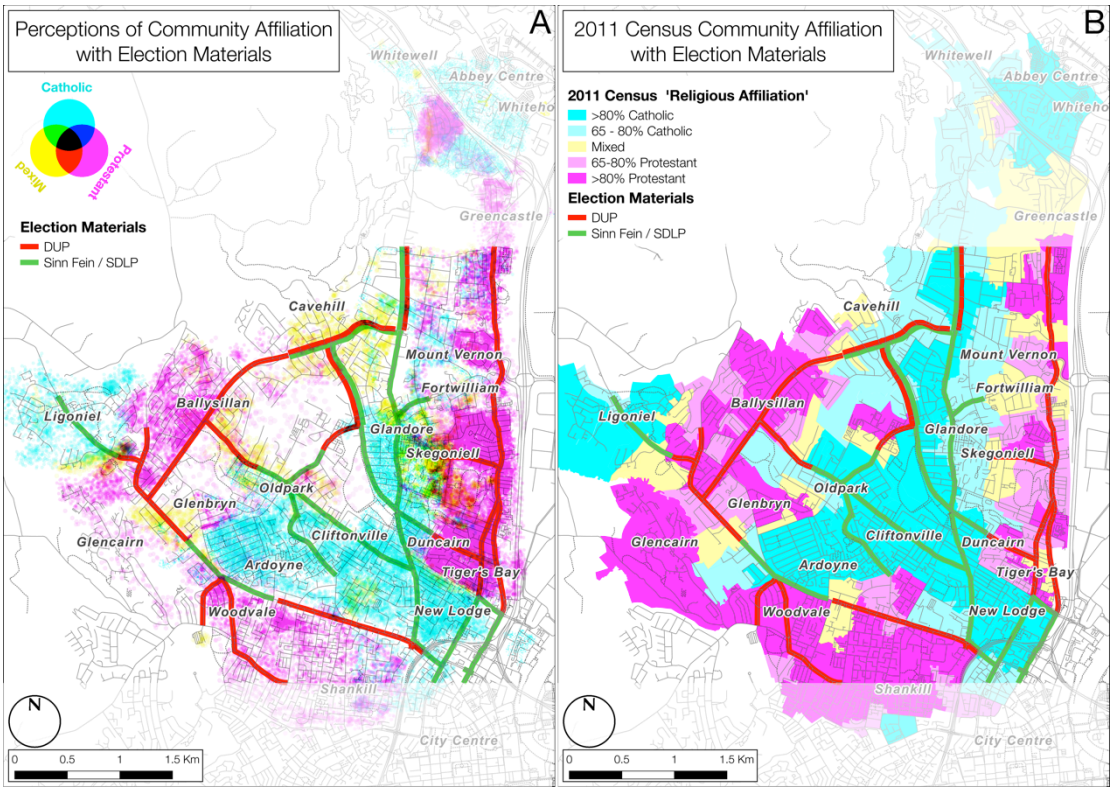

Figure 3: (A) Map of perceived community affiliation weighted by *mapping effort*, and overlaid with roadside election materials from June 2017. (B) 2011 Small Area census data, classified by % resident declared religious affiliation, and overlaid with roadside election materials from June 2017. Areas beyond the reach of the election material survey have been faded. *Road and suburb data © 2017 OpenStreetMap Contributors.*

Though no firm conclusions can be drawn with respect to the causes of mixing in the central part of the study area, there is a clear disparity between the census and local perceptions (as illustrated by the PGIS data) and actions (as illustrated by the election materials). The mixing is likely due to this area being considered more 'middle class', with residents perhaps therefore be expected to hold more moderate political attitudes than are typical in other parts of the study area. Several communities around Cavehill that have traditionally been seen as Protestant are now becoming more mixed, with

new Catholic families moving in and living alongside Protestants in these areas. There are also several community resources such as churches, shops, a popular Protestant school and a tennis club in this area, all of which may help to sustain a 'mixed' community.

Perceptions of Shared Spaces

'Shared public spaces' were generated by participants using the Spraycan in response to the question *"Please spray any local areas that you would define as public spaces that are shared by both communities"*. The visualisation of this dataset is shown in Figure 4A, using the same technique as Figure 2A, but this time with the respective colours referring to the self-reported community affiliation of each participant (e.g. cyan spray has been created by a Catholic participant). As might be expected in such a segregated part of the city, the areas that have been identified as 'shared' are quite small and isolated. It is also clear that there is a great deal of agreement between communities, with the majority of identified locations demonstrating at least some level of agreement, as denoted by the 'blending' towards the darker colours towards the centre of the legend. As with the prevalence of the lighter colours in Figure 2A, the prevalence of darker colours in Figure 4A reinforces the idea of 'shared understanding' between members of these segregated communities as to where they can and cannot integrate with members of the 'other' community.

In order to facilitate discussion of the perceived shared spaces, they will be compared with the dataset of GPS traces in order to see how perceptions of sharing from the PGIS participants relate to the behaviour recorded by the GPS participants (Figure 4B). The outstanding pattern in the GPS dataset is the seemingly indiscriminate mixing of communities along main roads. Grannis (1998) has previously commented upon the mixed usage of main roads in segregated areas and Murtagh (2010)

describes this activity as '*bubbling*': whereby residents of these communities exist within residential '*bubbles*', and use their cars to traverse the protected highways between those bubbles, limiting their interaction with symbols of sectarianism such as people, flags or graffiti.

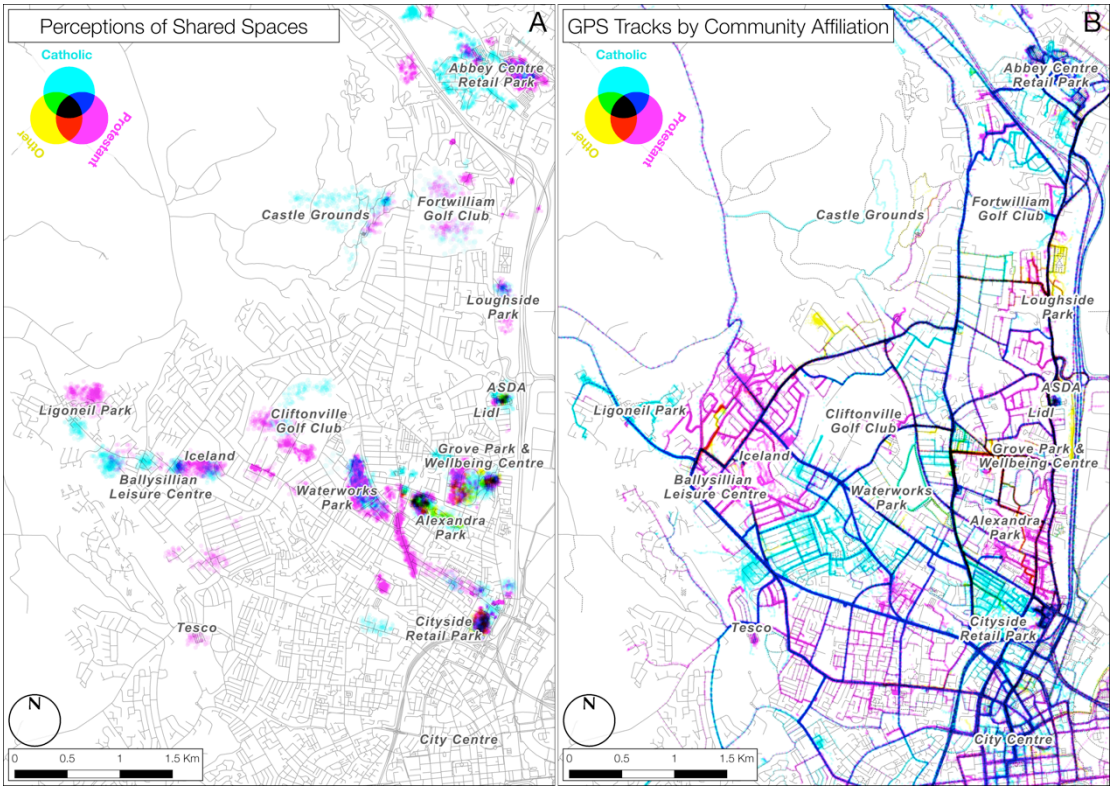

Figure 4: (A) Map visualising perceptions of shared spaces collected using the Spraycan, with data classified according to the community affiliation of the participant who created it and weighted by *mapping effort*. (B) GPS tracks, classified by participant community affiliation. Interactive versions of both maps are available at huckg.is/bmp. *Road data © 2017 OpenStreetMap Contributors.*

Whilst willing to traverse main roads in this manner, it is widely reported that most will not enter an area dominated by the 'other' community, even by car (Shirlow, 2003), and this is reflected in the GPS dataset in Figure 4B. Mixing is also evident in the GPS traces at locations that may be considered as integrated with the motor-transport network, such as the Abbey Centre Retail Park, which is a typical example of a bubble that can be safely accessed by both communities; and the city centre,

which has been established as a shared space due to extensive peace-making initiatives (Mitchell and Kelly, 2010). It is of interest that Hamilton et al. (2008:140) reported the Abbey Centre to be predominantly Protestant, whilst it is clearly shown to be shared by both the reported perceptions (Figure 4A) and recorded behaviours in these datasets (Figure 4B).

With respect to the shared spaces themselves, the most interesting outcome relates to the type of spaces that were identified as shared, rather than the spatial patterns or locations of those places. Many of them, particularly those with significant levels of agreement, may be considered as '*non-places'*: "*If place can be defined as relational, historical and concerned with identity, then a space which cannot be defined as relational, historical or concerned with identity will be a non-place*" (Augé, 2008:63). Shopping malls, motorways (freeways) and airport lounges all fall into this category of super-modern spaces that are defined by their functional and transient nature, and with which we do not form the relationships that are key to the 'sociological' notion of place (Augé, 2008). Such locations are considered as paradoxical, often leaving visitors with the feeling of 'knowing' the space even though they have never been there before. Examples of *non-places* that were identified as shared by participants include: the 'Abbey Centre' and 'Cityside' Retail Parks; the ASDA, Tesco, Lidl and Iceland supermarkets; the Grove, Valley and Ballysillan Leisure/Wellbeing Centres the Fortwilliam and Cliftonville Golf Clubs[2]; and the Yorkgate Train Station. It is perhaps unsurprising that *non-places* feature so prominently in this dataset; they are unavoidable in the course of daily urban life because cities are structured around them (Buchanan, 1999).

[2] Golf courses are argued as "*contrived non-places*" by Perkins (2017:56).

Farley and Roberts (2012:142) highlight the preponderance of *non-places* in, and resulting homogenisation of 'out of town' urban locations in their description of the '*edgelands*' of major British cities, in which every description ends with: "*There are branches of Starbucks, Carphone Warehouse, W.H. Smith, Dixons, Currys and McDonald's*". The dominant themes of *non-place* are consumption and transport: meaning that retail centres, supermarkets and chain restaurants are increasingly moving to 'out of town' locations in order to be integrated into the motorway network. When in such spaces, the visitor can experience anonymity and solitude, and need not invest emotionally in their surroundings (Buchanan, 1999). In the case of segregated cities such as Belfast, the combination of this anonymity and 'safe' access through motorised transport links reinforces the '*bubbling*' pattern described above, whereby the transport network and associated retail parks, leisure centres and transport links may be traversed in safety, providing an alternative venue to the city itself in order to avoid contact with the markers and risks of sectarianism. It is notable, for example, that all three of the identified leisure centres are located in overtly Protestant areas, but have large car parks and access via main roads, enabling them to act as a shared 'bubble' in spite of their immediate vicinity.

Cityside Retail Park is an example of both a *non-place* and *bubble* that was identified as 'shared' in this study. It was established in 1991 in an attempt to redevelop a conflicted sectarian location into a neutral space, forming part of the interface dividing New Lodge (Catholic) and Tiger's Bay (Protestant) and intended as a shared space in which members of both communities could engage in a peaceful and non-sectarian activity: consumption (Mitchell and Kelly, 2010). In spite of its close proximity to residential areas, Cityside is typically accessed by car rather than on foot, with many visitors accessing it via the adjacent motorway junction, meaning that they

are shielded from sectarian symbology such as flags and graffiti, and indeed from the 'dilapidated' housing stock in the immediate surrounding area (Mitchell and Kelly, 2010). It is unknown whether planners have tacitly or overtly used the development of *non-places* as a tool to promote sharing in other parts of the city; or sharing has simply developed 'organically' in these locations because of the sense of anonymity and lack of emotional ties that they offer. Either way, no such connection between *non-places* and sharing between segregated communities has previously been identified in the literature, and further investigation is required in order to better understand this relationship.

Cityside Retail Park also serves to illustrate that the relationship between the *perception* and *reality* of sharing is not always clear-cut. In spite of being an overt attempt at peace-building by the authorities, and indeed being identified as a 'shared' *non-place* in this study, Mitchell and Kelly (2010) report that a degree of segregation still remains in the retail park, with Protestant visitors predominantly using the 'lower' eastern entrance, whereas Catholic visitors tend to use the 'upper' western entrance. Figure 5A-C shows the spray patterns for perceptions of 'community affiliation' (A) and 'sharing' (B) alongside the GPS-traces (C) for Cityside. It is interesting that the exclusive Catholic use of the western entrance (circled in red, Figure 5C) is supported by the GPS traces. Whilst this pattern might alternatively be attributed to the location of the gates in relation to an adjacent Catholic community (clearly visible in Figure 5A), this could also suggest complexities in the nature of sharing, and further investigation into this phenomenon might reveal interesting nuances into the nature and patterns of sharing within the city.

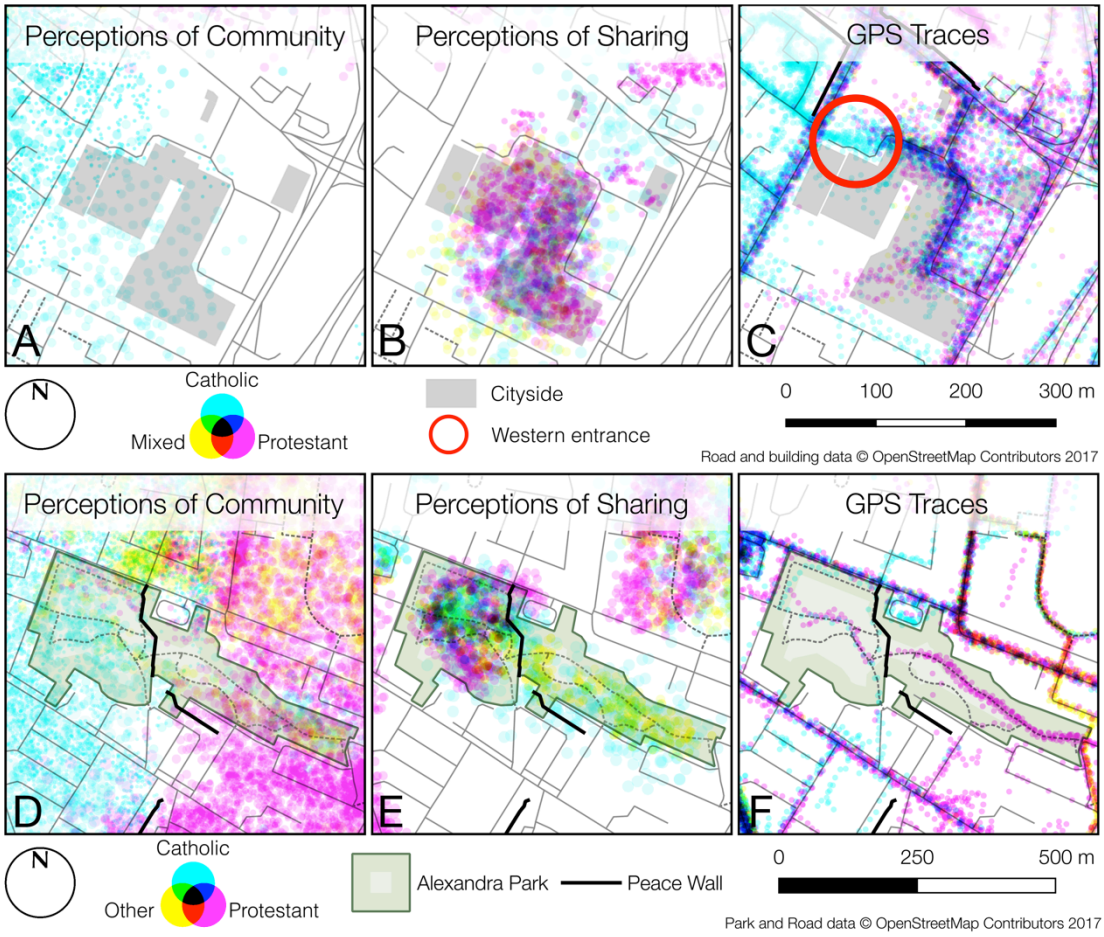

Figure 5: Maps visualising (A) spray patterns for perception of community affiliation, (B) spray patterns for perception of sharing and (C) GPS traces for Cityside retail park; and (D) spray patterns for perception of community affiliation, (E) spray patterns for perception of sharing and (F) GPS traces for Alexandra Park.

Not all of the places indicated as 'shared' can be described as *non-places*, however. The Castle Grounds, Loughside, Grove, Alexandra and Waterworks parks, for example, are prominent features in Figure 4A. Whilst parks are contrived and constructed landscapes that are designed to afford certain activities (play, exercise, dog walking, etc.), they do not fit with the consumption or transport-driven notion of '*non-place*' that is understood by Augé (2008) because they can exhibit *relational, historical* and *identity-based* characteristics. It is also notable that the parks identified in this study are not located 'out of town' nor integrated into the transport

infrastructure with car parks and direct links to main roads. Parks then do not exhibit *bubbling*, and perhaps represent not just public *spaces*, but public *places* that are understood as shared, which is quite different to the *placeless* bubbles identified above. Shared public places such as parks are then perhaps liminal spaces: existing on the interface between being public, accessible and open to all; and being parochial, territorial and sites of sectarian identification. Perhaps it is this '*in-between-ness*' that also distinguishes them from *non-places* such as shopping centres, and creates potential tensions where the symbolism of sectarian identification is constantly extruding into a public domain that is, simultaneously, defined as open for all to enjoy.

Upon closer inspection, it becomes clear that the parks identified in Figure 4A provide further and more overt examples of 'segregated sharing': not only with respect to access (as with Cityside), but also the activities taking place in the parks. Consider Alexandra Park (Figure 5D-F), which is a prominent example of segregation in Belfast as a result of being bisected by a peace wall, resulting in a 'Catholic side' (to the west) and a 'Protestant side' (to the east). There is a gate in the wall that was open during daylight hours during the study period, but was closed at night. The understanding of this segregation amongst residents is clearly demonstrated in Figure 5D, which shows perceived community affiliations both within the park and in the surrounding area. The Catholic and Protestant 'sides' are clearly visible on either side of the wall, which was not visible on the Google Map onto which participants sprayed these patterns. Interestingly, Figure 5E also suggests that perceptions of sharing have been influenced by the peace wall, with all three groups indicating the 'Catholic side' of the park as shared, but only Catholic and 'Other' participants indicating sharing on the 'Protestant side'. The GPS traces in Figure 5F support this pattern, with no

Catholic traces recorded to the east of the wall (on the 'Protestant side'), but both Catholic and Protestant to the west (on the 'Catholic side'). The patterns revealed in both case studies in Figure 5 therefore once again indicate interesting micro-geographical nuances in the way in which activity segregation appears to persist in a space that is perceived as shared.

Similar disconnections between the perception and action of sharing are evident in the GPS traces for other parks that were identified as shared in the Spraycan dataset: there were no Catholics recorded in Loughside Park, which is adjacent to a Protestant residential area; and no Protestants in Waterworks Park, which is immediately adjacent to a Catholic residential area, even though both groups identified both parks as 'shared' in the PGIS survey. These patterns might indicate a fundamental disconnect between the perceptions and actions of sharing in the communities, a lack of accessibility to parks that are surrounded by residences associated with the 'other' community, or simply a coincidence of sampling.

Leonard and McKnight (2015) note that what is understood by the terms 'neutral' and 'shared' can be understood differently by various social groups and actors across Belfast, and it is interesting that similar notions of 'segregated sharing' in Belfast are reported elsewhere in the literature. Roulston et al. (2017), for example, note that ostensibly 'shared' non-residential spaces in Northern Ireland are in fact used by Catholic and Protestant residents at different times of day or night (also Roulston and Young, 2013), limiting interaction between members of both communities. These considerations are important for further research into sharing using either participatory methods or GPS tracking. Researchers using participatory methods need to be mindful of variations in participants' interpretation of terms such as 'shared', whereas researchers employing GPS tracking need to ensure that analysis is temporal

as well as spatial, in order to distinguish sharing that is contemporaneous from that which is episodic.

The disconnection between the perception and reality of sharing appears much more prevalent in the parks than in the *non-places* that were identified above, all of which are supported in the GPS traces. Cityside Retail Park was the only example of 'segregated sharing' in a *non-place* that was found in the dataset, and this was with respect to access to the car park, rather than the activity itself (consumption). This is a different situation to that seen in the parks, where segregation is evident in the actual usage of the parks, as opposed to merely the access. This pattern might therefore lend further support to the relationship between sharing and *non-place*, and indeed between *non*-places and *shared public places* such as the parks. Further work is required here, in order to better understand the nature of *shared public places*, their relationship with *non-places* and the relationship of both of these with sharing amongst segregated communities.

Discussion

de Certeau (1984) presented two contrasting views of the city: the 'official', abstracted top-down view, and a more situated 'bottom-up' alternative. Whilst it has long been recognised that the latter approach can be greatly beneficial in understanding the complex social dynamics of a city (Dixon et al., 2008), the collection of 'bottom-up' spatial information through PGIS has been hampered by the lack of suitable representations for the situated perspectives of the public in relation to their daily encounters, interactions and perceptions. Modern concepts of the city have moved away from a mosaic of separate homogeneous areas and towards a complex and personal space, with its meanings constructed by the people living in it (Raanan and Shoval, 2014), and the spatial units with which geographers choose to represent

perceptions of the city must also change in order to reflect this in order to that the nuanced patterns of more modern views are not lost.

This article has therefore presented a novel, qualitative PGIS study that utilised an exploratory visualisation technique in order to investigate public perceptions of residential and activity space segregation in north Belfast. By utilising alternative, qualitative geographical representations to capture and analyse participants' perceptions of social phenomena such as segregation and sharing between communities, researchers can understand 'bottom up' perspectives that would otherwise be lost. This represents a clear step forward from previous PGIS approaches to understanding complex social phenomena such as activity space and segregation, and it is likely that these methods will prove valuable both in isolation, and in combination with individualistic quantitative approaches (e.g. Wong and Shaw, 2011; Farber et al., 2012) in order to enrich our understanding of complex social dynamics in divided cities such as Belfast.

There are, however, some limitations to this work, not least those relating to the sample, which was relatively small and homogeneous, comprising 33 residents from predominantly working-class areas in a single part of Belfast. As such, whilst the empirical patterns described above are certainly of interest, it is not possible to draw general conclusions from them based upon the PGIS dataset alone. However, as stated at the outset of this article, the localised segregation patterns in this area of Belfast are not the primary focus of this research. Instead, we have aimed to demonstrate the potential benefits of our methodological framework, as well as to formulate a set of hypotheses that might inform a future research agenda for investigation into segregation both in Belfast and across other segregated cities globally. The hypotheses that have been derived from the patterns presented above are as follows:

1. There is a positive relationship between '*non-places*' and the sharing of space between segregated communities.
2. Consumption is a significant driver for the sharing of space between segregated communities.
3. Amongst segregated communities, there can be a disconnection between the perception and the reality of sharing in a given space, particularly where that space does not conform to the notion of '*non-place*'.

The work presented here has been carried out using a moderately sized sample of residents from predominantly working-class areas in a single part of Belfast. Further work should therefore build upon this by undertaking a similar analysis at the city scale, with a much larger and more socio-economically diverse group of participants. The above hypotheses could also be tested with detailed investigations into the location and characteristics of places that are shared by members of segregated communities at the city scale. If the hypotheses are supported, then similar investigations could be undertaken in other segregated cities around the world, deepening our understanding of the ways in which segregated communities are able to share space. These findings might, in turn, influence policy and promote the desegregation of areas such as those studied here.

It would also be of interest to test these hypotheses against different forms of segregation. For example, the ethno-political segregation described in this research is not the only type of segregation that has been identified in the city, with Boal (1971), for example, focusing upon socio-economic segregation between two areas of the same religious affiliation, and finding that *"socio-economic territories exist that are every bit as sharply defined as are the more publicised religious territories of Belfast"* (Boal, 1971:247). Understanding whether or not one or more of the above

hypotheses are reflected in the sharing of space between communities that are segregated for different reasons would then also prove valuable to the understanding of wider issues of segregation.

It is important to note that many of the locations identified as 'shared' in this study (shopping centres, leisure centres, parks, etc.) are spaces that are often not well represented in administrative tessellations, frequently being simply conflated with adjacent residential areas. Such areas could therefore be overlooked if investigation was limited to census data alone. It must also be recognised that, whilst *non-places* such as shopping centres appear not to exhibit sectarian segregation, it must be considered that they are nevertheless spaces of exclusion and social division of a different kind. Attendance in such locations requires participation in consumption, with the homeless, groups of teenagers, and various other social categories routinely and deliberately targeted for exclusion in order to prevent interference with the activity of consumption.

In addition to providing insights into segregation in north Belfast, this work has also demonstrated that alternative PGIS methods can be effectively employed for the qualitative analysis of perceptions of segregation and sharing in a city. It is hoped that this study will promote further development of alternative interfaces and representations for investigating vague and indeterminately bound regions, including adaptations that incorporate further controls for assessing the quality of collected data. For example, information collected from the public alongside reported levels of confidence would permit the quantification of metrics such as belief, plausibility, disbelief and uncertainty using approaches such as Dempster-Shafer theory (e.g. Tangestani and Moore, 2002), which would permit greater levels of confidence in the

resulting patterns, and increase the likelihood of findings being able to influence policy and engender change.

There is also the potential for the results from investigations such as this to be 'given back' to the public for them to form their own interpretations of the data that has been collected. Understanding the public's interpretations of their own dataset may, in turn, shed additional light upon the patterns that we have found, or indeed identify patterns that we have overlooked. This cyclical collection, visualisation and re-interpretation of the data presents an interesting iterative approach to participatory mapping exercises, in which the public participants could be involved at all stages of data collection and analysis, which is far more in-keeping with the 'bottom-up' model proposed at the beginning of this article. Such an exercise could act as a form of community engagement, increasing awareness and understanding of the issues surrounding segregation, and perhaps even promoting constructive dialogue towards a shared goal of desegregation. This is arguably a much more empowering form of participation than asking people for perceptions and then deploying expert knowledge to form policy that might or might not enrol Volunteered Geographical Information (VGI). As such this new approach might play an important part in a community-led sharing of possible ways forward.

Conclusion

It was identified early in this article that flags represent one of the primary markers of sectarianism in Belfast. In their exploration of Britain's '*edgelands*', Farley and Roberts (2012) describe a different type of flag: those found amongst the 'out of town' retail parks that have featured so prominently in this analysis. They describe the way in which these flags might be "*subtly inoculating us against the extremes that flags can represent"* and their potential to "*gradually weaken the power of the old*

flags, robbing them of their specific potency" (Farley and Roberts, 2012:220-221). This notion that the activities of consumption might be eroding the activities associated with segregation and sectarianism in Belfast is supported by the research presented in this article. Similar patterns are also evident (though not explicitly identified) in the findings of others, such as Hamilton et al. (2008), whose interviews reveal that shopping centres, supermarkets and leisure centres tend to be viewed as shared by participants from six different communities in Northern Ireland, in contrast with local 'bread and milk' shops, which were considered to be segregated in all cases. Shirlow (2003:76-91) identified that for mixing between segregated communities to occur, the place has to be de-linked from the political and religious background. Though Shirlow was referring to residential areas, his assertion is perhaps more applicable here, as the emotional detachment from one's surroundings is precisely the effect that *non-places* have*,* as they are necessarily disconnected from the 'usual' sentiment that exists between people and place in favour of functionality, anonymity and solitude (Buchanan, 1999).

Hamilton et al. (2008:20) assert that "*Quantifying segregation gives only a limited understanding of the mechanisms through which segregation develops and is perpetuated, and it has proved insufficient for grasping the depth or drivers of segregation*". This research has therefore formulated the hypotheses presented above through the application of a novel combination of qualitative PGIS and visualisation techniques, which may be used either as a complementary or alternative approach to traditional methods for mapping segregation. That the resulting hypotheses appear to be supported both by the complementary datasets and elsewhere in the literature demonstrates the potential of this method in order to provide participatory or community mapping solutions that are better able to capture the day-to-day practices,

routines and experiences of ordinary people. It is hoped that this study will promote further development of alternative PGIS interfaces and representations for investigating vague and indeterminately bound regions, and that approaches such as those presented here can be developed further in order to provide a better understanding of segregation and sharing, and the spaces in which they take place.

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